



NSERC CREATE Summer Student Symposium • August 2012 • Vol. 2, No. 1

Metabolic Cost of Diagonal Striding and Double Poling in Cross Country Classic Skiing

Vetsch S, Crooks S, Killick A, Herzog W

Abstract

Several studies have compared physiological demands of two classic skiing techniques: double poling and diagonal striding. In diagonal striding, the skis propel the skier by alternating kick and glide phases between the left and right ski. Each ski kicks simultaneously with a push from the opposite pole. In double poling, the skier plants and pushes through with both poles simultaneously while the skis glide and do not contribute to impulse generation. Previous studies found that double poling was more economical by 10-26% than striding on flat and low grade surfaces at several speeds^{1,2,3}. However, if the oxygen consumption in double poling is lower at all given speeds, then why do skiers prefer to stride at slow speeds? The purpose of this study was to measure metabolic factors for the striding and double poling techniques in order to explain why skiers choose to stride under some conditions.

Nine elite male skiers performed a test on a rollerski treadmill. The treadmill was set to a 4% uphill grade and the speed was increased from 6km/h to 15km/h by increments of 3km/h. At each speed, the skier reached metabolic steady state for both the striding and double poling techniques. During the test, oxygen consumption and the respiratory exchange ratio ($RER = \text{CO}_2 \text{ produced} / \text{O}_2 \text{ consumed}$) were measured continuously.

The average oxygen cost for double poling was found to be 10% lower compared to striding across all speeds. However, for all but the highest speed, the RER values for double poling were 12% higher. RER indicates the intensity to which the recruited muscle mass is working. Therefore, these results suggest that double poling, although more economical, is likely more demanding on the recruited musculature and might lead to fast local fatigue. These results explain why double poling is not the preferred technique at slower speeds.

References

1. Hoffman, M.D. and Clifford, P. S., Physiological responses to different cross country skiing techniques on level terrain. *Med. Sci. Sports Exerc.* 1990, 22:841-848.
2. Rusko, H. Oxygen uptake and blood lactate concentration during diagonal skiing and double poling in cross country skiers. *Proceedings of the First IOC World Congress on Sport Sciences*, 1989, pp.108-109.
3. Saibene, F., Cortelli, G., Roi, G., Colombini, A. The energy cost of level cross-country skiing and the effect of the friction of the ski. *Eur. J. Appl. Physiol.* 1989, 58:791-795.